



High-Strain Rate Uniaxial Compression of Future Combat Systems (FCS) Generation One High-Energy Gun Propellants

by Michael G. Leadore

ARL-TR-2571

September 2001

Approved for public release; distribution is unlimited.

20011128 073

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

Citation of manufacturer's or trade names does not constitute an official endorsement or approval of the use thereof.

Destroy this report when it is no longer needed. Do not return it to the originator.

Army Research Laboratory

Aberdeen Proving Ground, MD 21005-5069

ARL-TR-2571

September 2001

High-Strain Rate Uniaxial Compression of Future Combat Systems (FCS) Generation One High-Energy Gun Propellants

Michael G. Leadore

Weapons and Materials Research Directorate, ARL

Approved for public release; distribution is unlimited.

Abstract

Six lots of Thiokol-manufactured Future Combat Systems (FCS) Generation One experimental high-energy gun propellants were tested in uniaxial compression. The materials were taken to ~60% strain at a strain rate of 100 per second, while conditioned at 21 °C, 63 °C, and -32 °C. The stress at yield, strain at yield, Young's modulus, failure modulus, incremental energy density, and fracture assessment values were recorded for each test. The average values achieved are reported.

Contents

List of Figures	v
List of Tables	vii
1. Introduction	1
2. Background	1
3. Approach and Results	3
4. Conclusions	4
5. References	10
Distribution List	11
Report Documentation Page	27

INTENTIONALLY LEFT BLANK.

List of Figures

Figure 1. M1A2 Abrams with 120-mm cannon.	1
Figure 2. Thiokol lots TGD013, TGD014, TGD015, TGD016, TGD017, and TGD018 as received.	2
Figure 3. Energetic material being loaded for a high-rate test.	3
Figure 4. Stress vs. strain plot of Thiokol propellants at 21 °C.	5
Figure 5. Stress vs. strain plot of Thiokol propellants at 63 °C.	6
Figure 6. Stress vs. strain plot of Thiokol propellants at -32 °C.	7
Figure 7. Tested specimens from Thiokol lots at 21 °C, 63 °C, and -32 °C.	7

INTENTIONALLY LEFT BLANK.

List of Tables

Table 1. Matrix summary and constituents with particle size.	2
Table 2. Mechanical properties of Thiokol lots.	4

1. Introduction

The following is the U.S. Army Research Laboratory's (ARL's) Material Test Systems (MTS) servo-hydraulic tester (SHT) high-rate mechanical response report of Generation One Future Combat System (FCS) Next Generation Experimental Gun Propellants. The six lots were manufactured by the Thiokol Corporation, at Brigham City, Utah Division (Test Sets 63-80, Fiscal 01). The lots are candidate propellants for the M1A2 Abrams with 120-mm cannon (Figure 1).

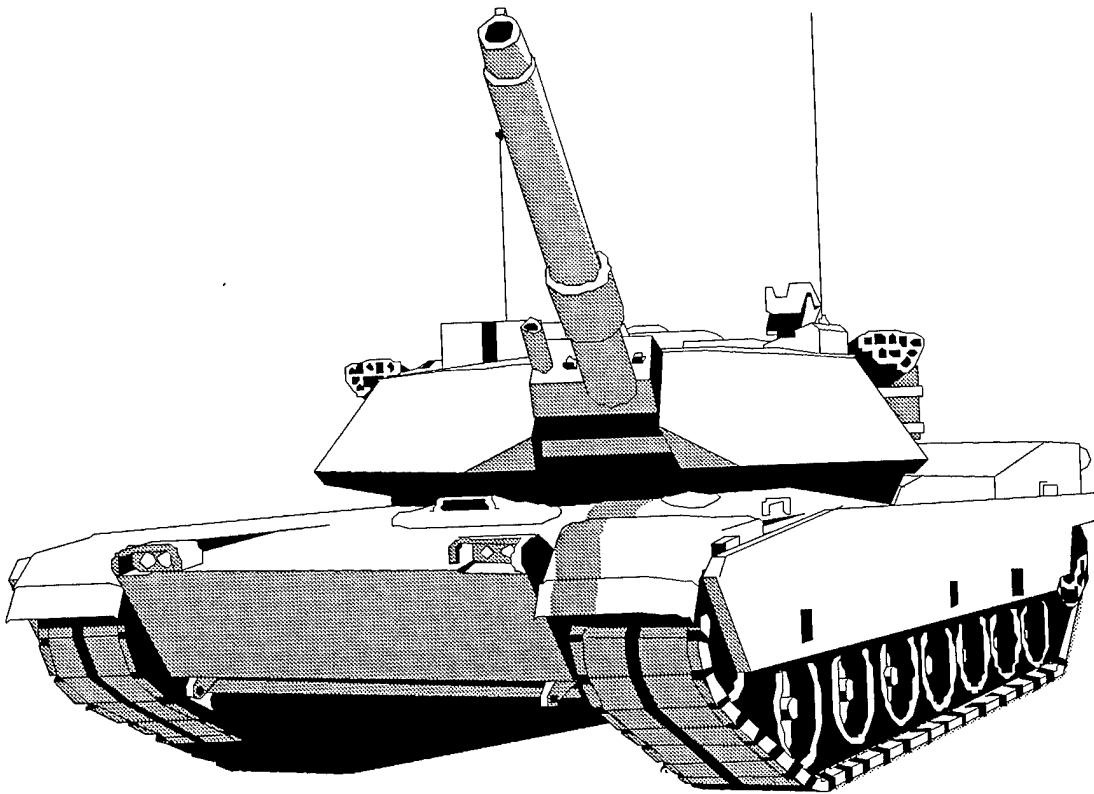


Figure 1. M1A2 Abrams with 120-mm cannon.

2. Background

Six lots of Generation One FCS propellants, identified as lots TGD013, TGD014, TGD015, TGD016, TGD017, and TGD018, were received from Thiokol-Utah (Figure 2). The next generation high-energy propellants were manufactured in a

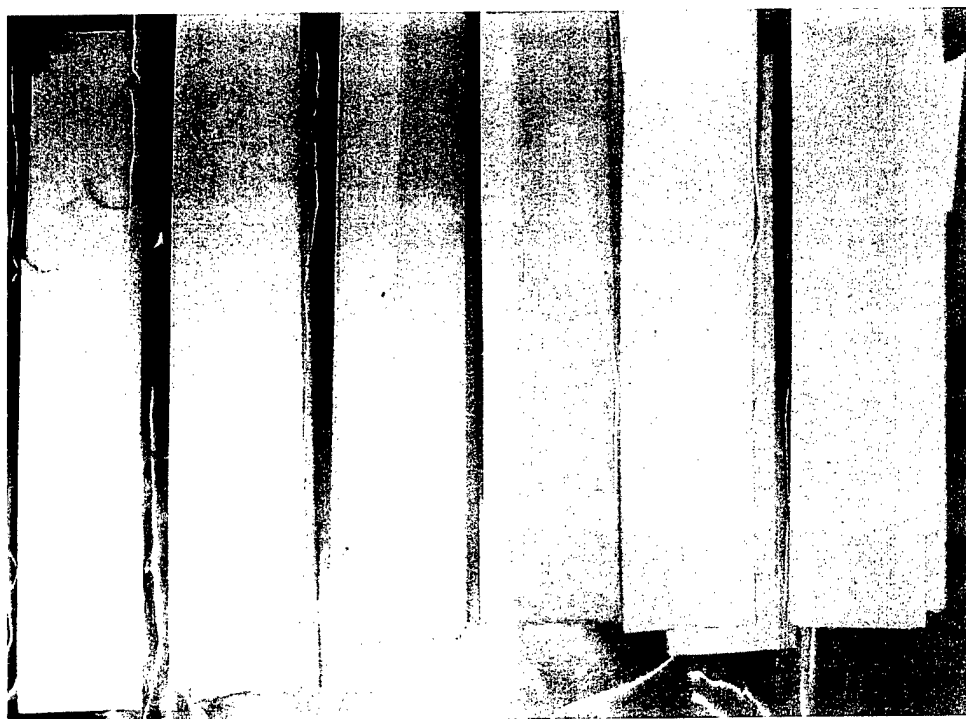


Figure 2. Thiokol lots TGD013, TGD014, TGD015, TGD016, TGD017, and TGD018 as received.

mixer and extruded thermally into sheets. The sheet materials had a thickness of ~2.0 mm. The sheets were cut into 25-mm \times 500-mm sheets, and several pieces from each lot of the experimental gun propellants were shipped to Mr. Charles Leveritt of ARL. They were recently tested for high-rate uniaxial compression mechanical response evaluation. The matrix summary and constituents with particle size (microns) as designated by Thiokol-Utah are shown in Table 1.

Table 1. Matrix summary and constituents with particle size.

Lot No.	%BAMOAMMO	%CL-20	%RDX
TGD013	22	78 (2 μ m)	0
TGD014	30	70 (2 μ m)	0
TGD015	22	78 (7 μ m)	0
TGD016	24	0	76 (2 μ m)
TGD017	30	0	70 (2 μ m)
TGD018	24	0	76 (7 μ m)

3. Approach and Results

The Thiokol-Utah propellant lots were received in solid sheet form and were without perforations. The lots were cut into samples and stacked resulting in a length to diameter (L/D) ratio of 0.93. Sample preparation was accomplished using a 12.68-mm stainless steel hole punch. Sample ends were machined so that the surfaces were flat, parallel to each other, and perpendicular to the extruded axis.

MTS SHT mechanical properties tests [1-7] were conducted on several specimens under each test condition (Figure 3). Strain rates of 128.0 s⁻¹, were achieved. The specimens were taken to failure at ambient pressure to ~60% end strain while conditioned at temperatures of 21 °C, 63 °C, and -32 °C. The stress at failure, strain at failure, the modulus, failure modulus, the incremental energy density, and the fracture assessment value were recorded for each test. The average values are listed in Table 2.

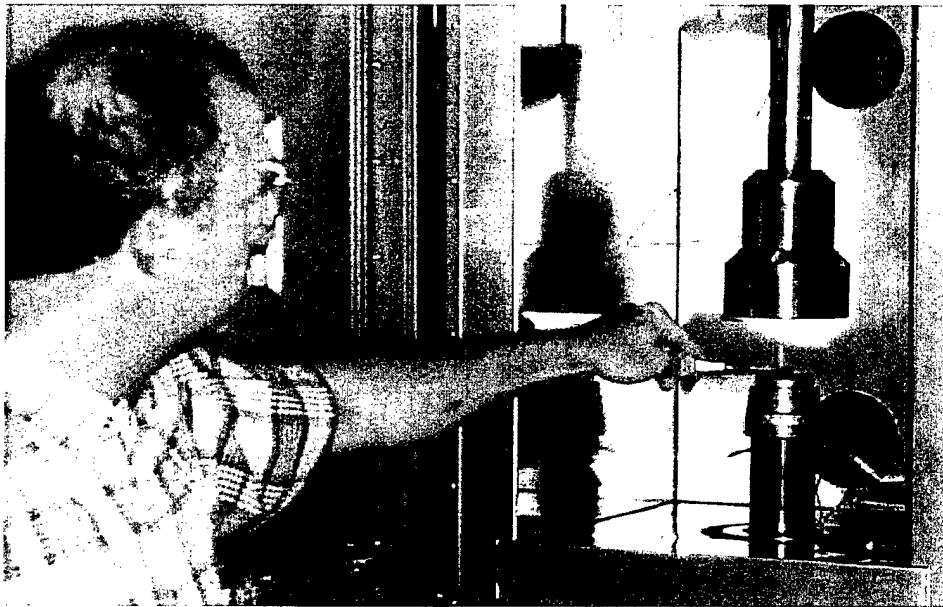


Figure 3. Energetic material being loaded for a high-rate test.

Table 2. Mechanical properties of Thiokol lots.

Lot	Stress at Failure (MPa)	Strain at Failure (%)	Modulus (GPa)	Failure Modulus ^a (GPa)	IED ^b (MPa)	FAV ^c (MPa)
at 21 °C						
TGD013	56.20	10.10	0.801	0.009	7.36	1AB
TGD014	39.23	13.34	0.391	0.125	6.81	1AB
TGD015	33.46	7.70	0.576	0.086	7.68	1AB
TGD016	39.03	12.05	0.416	0.072	8.31	1AB
TGD017	34.22	19.27	0.193	0.059	6.37	0B
TGD018	40.58	11.77	0.440	0.009	8.77	1AB
at 63 °C						
TGD013	21.58	12.57	0.211	0.021	4.60	0B
TGD014	12.79	13.50	0.074	0.054	2.76	0B
TGD015	15.82	12.75	0.133	0.037	3.38	0B
TGD016	8.98	13.05	0.126	0.016	3.72	1AB
TGD017	9.65	16.68	0.041	0.042	1.94	0B
TGD018	8.73	12.39	0.166	0.038	4.08	1AB
at -32 °C						
TGD013	93.86	5.23	2.75	-0.290	16.70	7AS
TGD014	85.67	6.05	2.01	-0.058	20.20	3AS
TGD015	91.78	5.15	2.42	-0.680	12.88	7AS
TGD016	76.03	9.36	1.14	-0.064	15.90	4AS
TGD017	62.67	12.38	0.765	-0.018	12.74	2AS
TGD018	81.86	6.60	1.72	-0.101	17.40	4AS

^aThe failure modulus (slope of the curve after failure) has been added. Generally, the lower the value, the worse the material (i.e., negative value indicates the material is unable to sustain load). A positive value indicates a positive failure slope (i.e., the material is better able to support load after failure).

^bThe IED (incremental energy density) value reported is the amount of energy per unit volume absorbed at 25% strain, this includes a portion of the area located beneath the stress/strain curve.

^cThe tested specimens were assigned a fracture assessment value (FAV). The values range from 0 (no observed fracturing) through 9 (severe fracturing observed). The type of fracture was also characterized using the following methodology: A = axial fracture, S = shear fracture, B = barreling/deformation, R = radial splitting (i.e., 9A indicates the tested specimens showed a severe amount of axial fracture).

4. Conclusions

A matrix of Thiokol-manufactured lots designated as TGD013, TGD014, TGD015, TGD016, TGD017, and TGD018 next generation experimental FCS gun propellants were tested for mechanical response evaluation at ambient pressure

while conditioned at 21 °C, 63 °C, and -32 °C. The materials were tested in uniaxial compression to ~60% end strain using a deformation rate of 1.31 m/s.

At 21 °C, the TGD lots provided good mechanical response at high-strain rate. It was noted when comparing the Young's modulus that lots TGD014 and TGD017 were a bit "softer" than the remaining lots. This was expected as these lots contained additional plasticizer. The failure modulus values were all positive values indicating the lots did well at sustaining load. The tested specimens showed minimal (Figure 4) axial fracture and barreling.

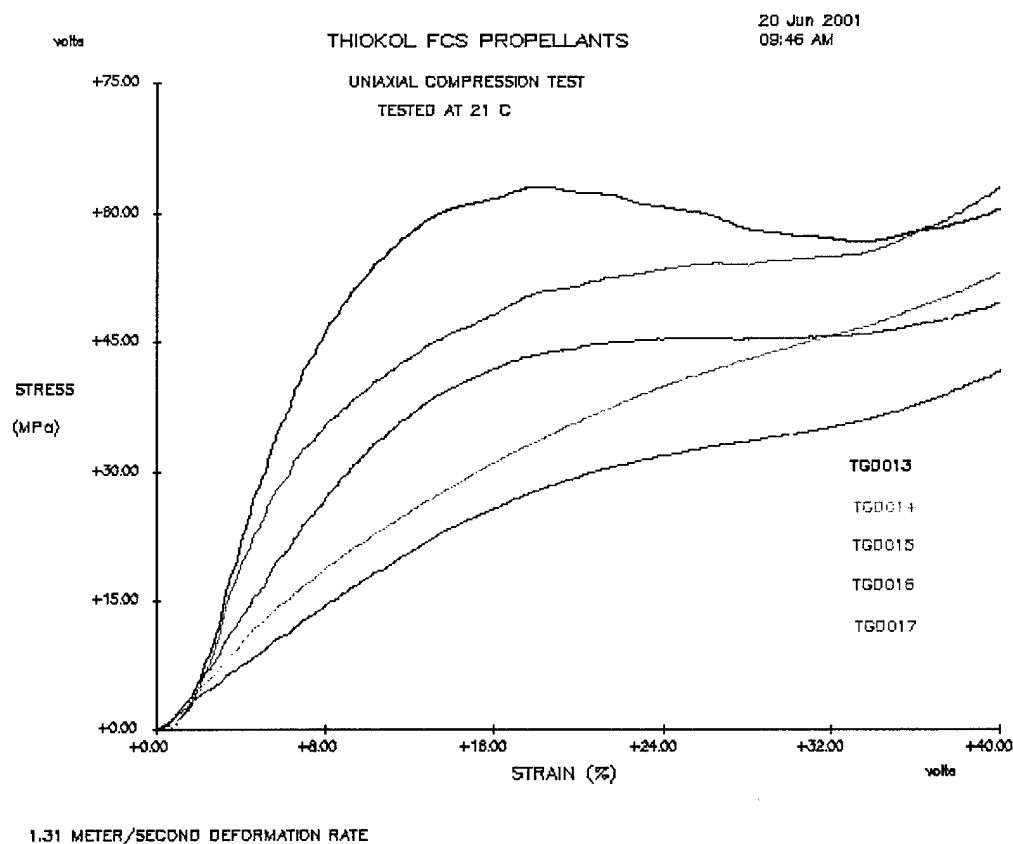


Figure 4. Stress vs. strain plot of Thiokol propellants at 21 °C.

At 63 °C, "softening" of the six lots was noted as a result of the higher testing temperature. The tested specimens showed minimal permanent deformation and barreling. Due to the thermal softening, the stress/strain plots showed lots TGD014 and TGD017 loading with non-definitive stress at yield (Figure 5), then continuing to workharden to ~40% strain. When comparing the Young's modulus at 63 °C and 21 °C for lots TGD014 and TGD017, a factor of five decrease was noted. This would indicate thermal softening and, thus, increasing

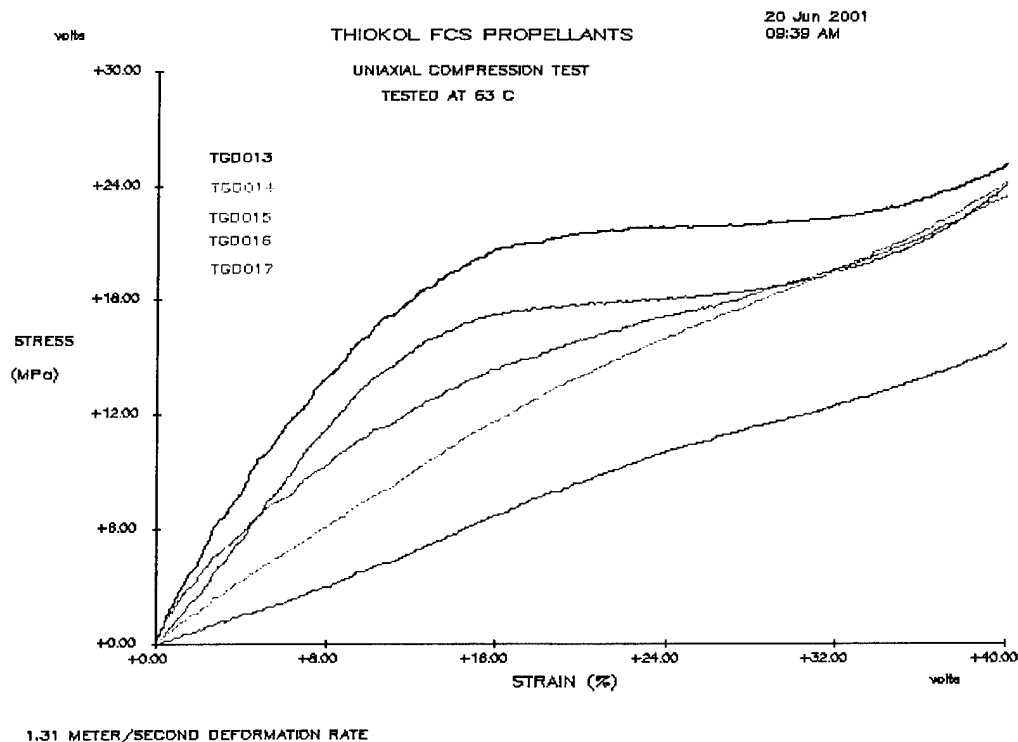


Figure 5. Stress vs. strain plot of Thiokol propellants at 63 °C.

the probability of material agglomeration at temperatures at or around 63 °C. The thermal softening of lots TGD014 and TGD017 could cause incomplete combustion of the materials in a ballistic environment. The tested specimens (Figure 6) showed permanent deformation and barreling.

At -32 °C, the tested specimens from lots TGD013 and TGD015 suffered moderate to severe amounts of axial and shear fracture, likely causing an increase in available surface area and thus, increasing the burn rate of the material. The stress/strain plot (Figure 6) for the lots also correlates well with the physical damage observed in the tested specimens. Lots TGD014, TGD016, and TGD017 showed the better failure modulus values, which indicated these lots sustained load much better and also suffered less physical damage than the remaining lots. When comparing the Young's modulus values for lots TGD013 and TGD015 at 21 °C and -32 °C, a factor of four increase was noted, indicating these two lots had likely made a glass transition. The failure modulus values achieved at -32 °C also supports this observation.

Overall, the 21 °C and 63 °C test results were quite good. However, lots TGD014 and TGD017 suffered much softening at 63 °C. At -32 °C, lots TGD014, TGD016, TGD017, and TGD018 showed the better mechanical response (Figure 7). Lots TGD013 and TGD015 were much too "brittle" and suffered prolific fracture.

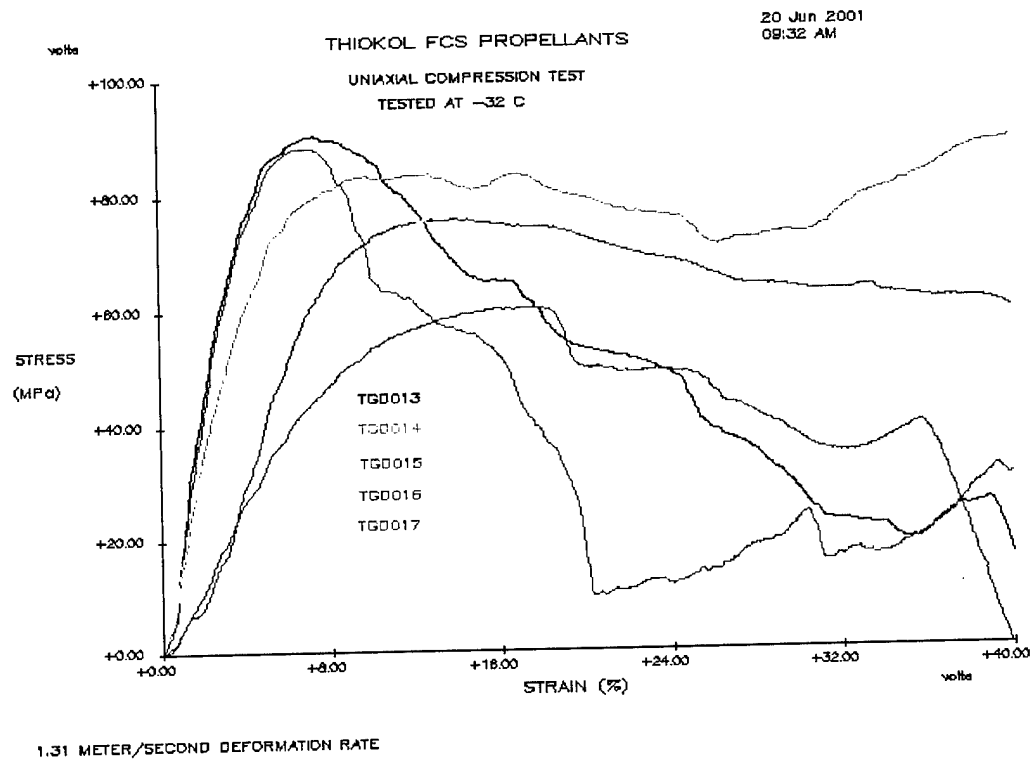


Figure 6. Stress vs. strain plot of Thiokol propellants at -32 °C.

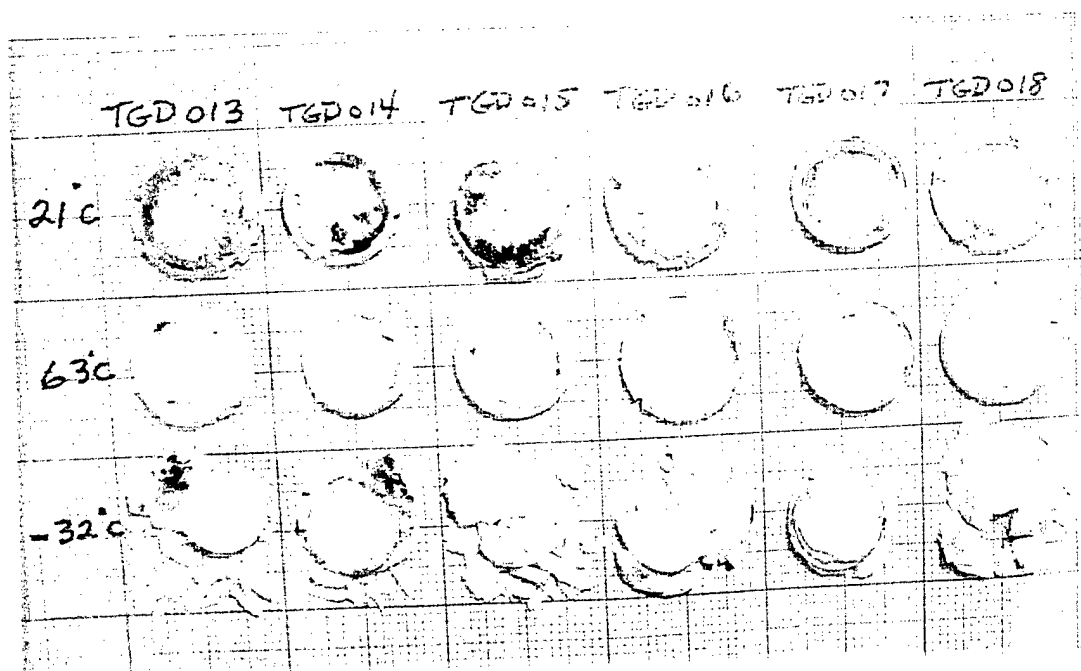


Figure 7. Tested specimens from Thiokol lots at 21 °C, 63 °C, and -32 °C.

INTENTIONALLY LEFT BLANK.

5. References

1. Gazonas, G. A. "The Mechanical Response of M30, XM39, and JA2 Propellants at Strain Rates from 10⁻² to 250 Sec⁻¹." BRL-TR-3181, U.S. Army Ballistic Research Laboratory, Aberdeen Proving Ground, MD, January 1991.
2. Lieb, R. J. "Impact-Generated Surface Area in Gun Propellant." BRL-TR-2946, U.S. Army Ballistic Research Laboratory, Aberdeen Proving Ground, MD, November 1988.
3. Lieb, R. J., and J. J. Rocchio. "High Strain Rate Mechanical Properties Testing on Lots of Solid Gun Propellant with Deviant Interior Ballistic Performance." *1982 JANNAF Structures and Mechanical Behavior Subcommittee Meeting*, CPIA Publication 368, pp. 23-38, October 1982.
4. Leadore, M. G. "MTS Servo-Hydraulic Tester (SHT) Mechanical Properties Evaluation of M43 Propellants." ARL-TN-5, U.S. Army Research Laboratory, Aberdeen Proving Ground, MD, March 1993.
5. Leadore, M. G., and C. J. Gillich. "Material Testing System (MTS) Servo-Hydraulic Tester (SHT) Mechanical Response of Energetic Thermal Plastic Elastomer (ETPE) RDX Based Propellants." ARL-TN-28, U.S. Army Research Laboratory, Aberdeen Proving Ground, MD, April 1994.
6. Leadore, M. G. "Mechanical Response of Energetic Thermoplastic Elastomer Low-Vulnerability Ammunition (ETPE-LOVA) RDX-Based, TNAZ-Based, and CL-20-Based Gun Propellants." ARL-TN-64, U.S. Army Research Laboratory, Aberdeen Proving Ground, MD, March 1996.
7. Lieb, R. J. Personal communication. U.S. Army Research Laboratory, Aberdeen Proving Ground, MD, June 2001.

INTENTIONALLY LEFT BLANK.

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>	<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
2	DEFENSE TECHNICAL INFORMATION CENTER DTIC OCA 8725 JOHN J KINGMAN RD STE 0944 FT BELVOIR VA 22060-6218	3	DIRECTOR US ARMY RESEARCH LAB AMSRL CI LL 2800 POWDER MILL RD ADELPHI MD 20783-1197
1	HQDA DAMO FDT 400 ARMY PENTAGON WASHINGTON DC 20310-0460	3	DIRECTOR US ARMY RESEARCH LAB AMSRL CI IS T 2800 POWDER MILL RD ADELPHI MD 20783-1197
1	OSD OUSD(A&T)/ODDR&E(R) DR R J TREW 3800 DEFENSE PENTAGON WASHINGTON DC 20301-3800		<u>ABERDEEN PROVING GROUND</u>
1	COMMANDING GENERAL US ARMY MATERIEL CMD AMCRDA TF 5001 EISENHOWER AVE ALEXANDRIA VA 22333-0001	2	DIR USARL AMSRL CI LP (BLDG 305)
1	INST FOR ADVNCD TCHNLGY THE UNIV OF TEXAS AT AUSTIN 3925 W BRAKER LN STE 400 AUSTIN TX 78759-5316		
1	US MILITARY ACADEMY MATH SCI CTR EXCELLENCE MADN MATH MAJ HUBER THAYER HALL WEST POINT NY 10996-1786		
1	DIRECTOR US ARMY RESEARCH LAB AMSRL D DR D SMITH 2800 POWDER MILL RD ADELPHI MD 20783-1197		
1	DIRECTOR US ARMY RESEARCH LAB AMSRL CI AI R 2800 POWDER MILL RD ADELPHI MD 20783-1197		

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>	<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
1	DIRECTOR US ARMY RESEARCH LAB AMSRL CP CA D SNIDER 2800 POWDER MILL RD ADELPHI MD 20783-1145	2	COMMANDER US ARMY ARDEC AMSTA AR AE WW E BAKER J PEARSON PICATINNY ARSENAL NJ 07806-5000
1	DIRECTOR US ARMY RESEARCH LAB AMSRL CI IS R 2800 POWDER MILL RD ADELPHI MD 20783-1145	1	COMMANDER US ARMY ARDEC AMSTA AR TD C SPINELLI PICATINNY ARSENAL NJ 07806-5000
3	DIRECTOR US ARMY RESEARCH LAB AMSRL OP SD TL 2800 POWDER MILL RD ADELPHI MD 20783-1145	1	COMMANDER US ARMY ARDEC AMSTA AR FSE PICATINNY ARSENAL NJ 07806-5000
1	DIRECTOR US ARMY RESEARCH LAB AMSRL CI IS T 2800 POWDER MILL RD ADELPHI MD 20783-1145	6	COMMANDER US ARMY ARDEC AMSTA AR CCH A W ANDREWS S MUSALLI R CARR M LUCIANO E LOGSDEN T LOUZEIRO PICATINNY ARSENAL NJ 07806-5000
1	DIRECTOR DA OASARDA SARD SO 103 ARMY PENTAGON WASHINGTON DC 20310-0103	1	COMMANDER US ARMY ARDEC AMSTA AR CCH P J LUTZ PICATINNY ARSENAL NJ 07806-5000
1	DPTY ASST SECY FOR R&T SARD TT THE PENTAGON RM 3EA79 WASHINGTON DC 20301-7100	1	COMMANDER US ARMY ARDEC AMSTA AR FSF T C LIVECCHIA PICATINNY ARSENAL NJ 07806-5000
1	COMMANDER US ARMY MATERIEL CMD AMXMI INT 5001 EISENHOWER AVE ALEXANDRIA VA 22333-0001	1	COMMANDER US ARMY ARDEC AMSTA ASF PICATINNY ARSENAL NJ 07806-5000
4	COMMANDER US ARMY ARDEC AMSTA AR CC G PAYNE J GEHBAUER C BAULIEU H OPAT PICATINNY ARSENAL NJ 07806-5000		

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
1	COMMANDER US ARMY ARDEC AMSTA AR QAC T C C PATEL PICATINNY ARSENAL NJ 07806-5000
1	COMMANDER US ARMY ARDEC AMSTA AR M D DEMELLA PICATINNY ARSENAL NJ 07806-5000
3	COMMANDER US ARMY ARDEC AMSTA AR FSA A WARNASH B MACHAK M CHIEFA PICATINNY ARSENAL NJ 07806-5000
2	COMMANDER US ARMY ARDEC AMSTA AR FSP G M SCHIKSNIS D CARLUCCI PICATINNY ARSENAL NJ 07806-5000
1	COMMANDER US ARMY ARDEC AMSTA AR FSP A P KISATSKY PICATINNY ARSENAL NJ 07806-5000
2	COMMANDER US ARMY ARDEC AMSTA AR CCH C H CHANIN S CHICO PICATINNY ARSENAL NJ 07806-5000
1	COMMANDER US ARMY ARDEC AMSTA AR QAC T D RIGOGLIOSO PICATINNY ARSENAL NJ 07806-5000

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
1	COMMANDER US ARMY ARDEC AMSTA AR WET T SACHAR BLDG 172 PICATINNY ARSENAL NJ 07806-5000
9	COMMANDER US ARMY ARDEC AMSTA AR CCH B P DONADIA F DONLON P VALENTI C KNUTSON G EUSTICE S PATEL G WAGNECZ R SAYER F CHANG PICATINNY ARSENAL NJ 07806-5000
6	COMMANDER US ARMY ARDEC AMSTA AR CCL F PUZYCKI R MCHUGH D CONWAY E JAROSZEWSKI R SCHLENNER M CLUNE PICATINNY ARSENAL NJ 07806-5000
5	PM SADARM SFAE GCSS SD COL B ELLIS M DEVINE W DEMASSI J PRITCHARD S HROWNAK PICATINNY ARSENAL NJ 07806-5000
1	US ARMY ARDEC INTELLIGENCE SPECIALIST AMSTA AR WEL F M GUERRIERE PICATINNY ARSENAL NJ 07806-5000

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
2	PEO FIELD ARTILLERY SYS SFAE FAS PM H GOLDMAN T MCWILLIAMS PICATINNY ARSENAL NJ 07806-5000
12	PM TMAS SFAE GSSC TMA R MORRIS C KIMKER D GUZIEWICZ E KOPACZ R ROESER R DARCY R KOWALSKI R MCDANOLDS L D ULISSE C ROLLER J MCGREEN B PATTTER PICATINNY ARSENAL NJ 07806-5000
1	COMMANDER US ARMY ARDEC AMSTA AR WEA J BRESCIA PICATINNY ARSENAL NJ 07806-5000
1	COMMANDER US ARMY ARDEC PRODUCTION BASE MODERN ACTY AMSMC PBM K PICATINNY ARSENAL NJ 07806-5000
1	COMMANDER US ARMY TACOM PM ABRAMS SFAE ASM AB 6501 ELEVEN MILE RD WARREN MI 48397-5000
1	COMMANDER US ARMY TACOM AMSTA SF WARREN MI 48397-5000

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
1	COMMANDER US ARMY TACOM PM BFVS SFAE GCSS W BV 6501 ELEVEN MILE RD WARREN MI 48397-5000
1	COMMANDER US ARMY TACOM PM RDT&E SFAE GCSS W AB J GODELL 6501 ELEVEN MILE RD WARREN MI 48397-5000
2	COMMANDER US ARMY TACOM PM SURV SYS SFAE ASM SS T DEAN SFAE GCSS W GSI M D COCHRAN 6501 ELEVEN MILE RD WARREN MI 48397-5000
1	US ARMY CERL R LAMPO 2902 NEWMARK DR CHAMPAIGN IL 61822
1	COMMANDER US ARMY TACOM PM SURVIVABLE SYSTEMS SFAE GCSS W GSI H M RYZYI 6501 ELEVEN MILE RD WARREN MI 48397-5000
1	COMMANDER US ARMY TACOM CHIEF ABRAMS TESTING SFAE GCSS W AB QT T KRASKIEWICZ 6501 ELEVEN MILE RD WARREN MI 48397-5000
1	COMMANDER WATERVLIET ARSENAL SMCWV QAE Q B VANINA BLDG 44 WATERVLIET NY 12189-4050

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
3	ARMOR SCHOOL ATZK TD R BAUEN J BERG A POMEY FT KNOX KY 40121
14	COMMANDER US ARMY TACOM AMSTA TR R R MCCLELLAND D THOMAS J BENNETT D HANSEN AMSTA JSK S GOODMAN J FLORENCE K IYER D TEMPLETON A SCHUMACHER AMSTA TR D D OSTBERG L HINOJOSA B RAJU AMSTA CS SF H HUTCHINSON F SCHWARZ WARREN MI 48397-5000
14	BENET LABORATORIES AMSTA AR CCB R FISCELLA M SOJA E KATHE M SCAVULO G SPENCER P WHEELER S KRUPSKI J VASILAKIS G FRIAR R HASENBEIN AMSTA CCB R S SOPOK E HYLAND D CRAYON R DILLON WATERVLIET NY 12189-4050

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
2	HQ IOC TANK AMMUNITION TEAM AMSIO SMT R CRAWFORD W HARRIS ROCK ISLAND IL 61299-6000
2	COMMANDER US ARMY AMCOM AVIATION APPLIED TECH DIR J SCHUCK FT EUSTIS VA 23604-5577
1	DIRECTOR US ARMY AMCOM SFAE AV RAM TV D CALDWELL BLDG 5300 REDSTONE ARSENAL AL 35898
2	US ARMY CORPS OF ENGINEERS CERD C T LIU CEW ET T TAN 20 MASS AVE NW WASHINGTON DC 20314
1	US ARMY COLD REGIONS RSCH & ENGRNG LAB P DUTTA 72 LYME RD HANOVER NH 03755
1	USA SBCCOM PM SOLDIER SPT AMSSB PM RSS A J CONNORS KANSAS ST NATICK MA 01760-5057
2	USA SBCCOM MATERIAL SCIENCE TEAM AMSSB RSS J HERBERT M SENNETT KANSAS ST NATICK MA 01760-5057

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>	<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
2	OFC OF NAVAL RESEARCH D SIEGEL CODE 351 J KELLY 800 N QUINCY ST ARLINGTON VA 22217-5660	8	US ARMY SBCCOM SOLDIER SYSTEMS CENTER BALLISTICS TEAM J WARD W ZUKAS P CUNNIFF J SONG MARINE CORPS TEAM J MACKIEWICZ BUS AREA ADVOCACY TEAM W HASKELL AMSSB RCP SS W NYKVIST S BEAUDOIN KANSAS ST NATICK MA 01760-5019
1	NAVAL SURFACE WARFARE CTR DAHLGREN DIV CODE G06 DAHLGREN VA 22448		
1	NAVAL SURFACE WARFARE CTR TECH LIBRARY CODE 323 17320 DAHLGREN RD DAHLGREN VA 22448		
1	NAVAL SURFACE WARFARE CTR CRANE DIVISION M JOHNSON CODE 20H4 LOUISVILLE KY 40214-5245	9	US ARMY RESEARCH OFC A CROWSON H EVERETT J PRATER G ANDERSON D STEPP D KISEROW J CHANG PO BOX 12211 RESEARCH TRIANGLE PARK NC 27709-2211
2	NAVAL SURFACE WARFARE CTR U SORATHIA C WILLIAMS CD 6551 9500 MACARTHUR BLVD WEST BETHESDA MD 20817	1	NAVAL SEA SYSTEMS CMD D LIESE 2531 JEFFERSON DAVIS HWY ARLINGTON VA 22242-5160
2	COMMANDER NAVAL SURFACE WARFARE CTR CARDEROCK DIVISION R PETERSON CODE 2020 M CRITCHFIELD CODE 1730 BETHESDA MD 20084	1	NAVAL SURFACE WARFARE CTR M LACY CODE B02 17320 DAHLGREN RD DAHLGREN VA 22448
8	DIRECTOR US ARMY NATIONAL GROUND INTELLIGENCE CTR D LEITER M HOLTUS M WOLFE S MINGLEDORF J GASTON W GSTATTENBAUER R WARNER J CRIDER 220 SEVENTH ST NE CHARLOTTESVILLE VA 22091	8	NAVAL SURFACE WARFARE CTR J FRANCIS CODE G30 D WILSON CODE G32 R D COOPER CODE G32 J FRAYSSE CODE G33 E ROWE CODE G33 T DURAN CODE G33 L DE SIMONE CODE G33 R HUBBARD CODE G33 DAHLGREN VA 22448

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>	<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
2	NAVAL SURFACE WARFARE CTR CARDEROCK DIVISION R CRANE CODE 2802 C WILLIAMS CODE 6553 3A LEGGETT CIR BETHESDA MD 20054-5000	1	OSD JOINT CCD TEST FORCE OSD JCCD R WILLIAMS 3909 HALLS FERRY RD VICKSBURG MS 29180-6199
1	EXPEDITIONARY WARFARE DIV N85 F SHOUP 2000 NAVY PENTAGON WASHINGTON DC 20350-2000	3	DARPA M VANFOSSSEN S WAX L CHRISTODOULOU 3701 N FAIRFAX DR ARLINGTON VA 22203-1714
1	AFRL MLBC 2941 P ST RM 136 WRIGHT PATTERSON AFB OH 45433-7750	2	SERDP PROGRAM OFC PM P2 C PELLERIN B SMITH 901 N STUART ST STE 303 ARLINGTON VA 22203
1	AFRL MLSS R THOMSON 2179 12TH ST RM 122 WRIGHT PATTERSON AFB OH 45433-7718	1	FAA MIL HDBK 17 CHAIR L ILCEWICZ 1601 LIND AVE SW ANM 115N RESTON VA 98055
2	AFRL F ABRAMS J BROWN BLDG 653 2977 P ST STE 6 WRIGHT PATTERSON AFB OH 45433-7739	1	US DEPT OF ENERGY OFC OF ENVIRONMENTAL MANAGEMENT P RITZCOVAN 19901 GERMANTOWN RD GERMANTOWN MD 20874-1928
1	WATERWAYS EXPERIMENT D SCOTT 3909 HALLS FERRY RD SC C VICKSBURG MS 39180	1	DIRECTOR LOS ALAMOS NATIONAL LAB F L ADDESSIO T 3 MS 5000 PO BOX 1633 LOS ALAMOS NM 87545
5	DIRECTOR LLNL R CHRISTENSEN S DETERESA F MAGNESS M FINGER MS 313 M MURPHY L 282 PO BOX 808 LIVERMORE CA 94550	1	OAK RIDGE NATIONAL LABORATORY R M DAVIS PO BOX 2008 OAK RIDGE TN 37831-6195
1	AFRL MLS OL L COULTER 7278 4TH ST BLDG 100 BAY D HILL AFB UT 84056-5205	1	OAK RIDGE NATIONAL LABORATORY C EBERLE MS 8048 PO BOX 2008 OAK RIDGE TN 37831

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
3	DIRECTOR SANDIA NATIONAL LABS APPLIED MECHANICS DEPT MS 9042 J HANDROCK Y R KAN J LAUFFER PO BOX 969 LIVERMORE CA 94551-0969
1	OAK RIDGE NATIONAL LABORATORY C D WARREN MS 8039 PO BOX 2008 OAK RIDGE TN 37831
5	NIST J DUNKERS M VANLANDINGHAM MS 8621 J CHIN MS 8621 J MARTIN MS 8621 D DUTHINH MS 8611 100 BUREAU DR GAITHERSBURG MD 20899
1	HYDROGEOLOGIC INC SERDP ESTCP SPT OFC S WALSH 1155 HERNDON PKWY STE 900 HERNDON VA 20170
3	NASA LANGLEY RSCH CTR AMSRL VS W ELBER MS 266 F BARTLETT JR MS 266 G FARLEY MS 266 HAMPTON VA 23681-0001
1	NASA LANGLEY RSCH CTR T GATES MS 188E HAMPTON VA 23661-3400
1	FHWA E MUNLEY 6300 GEORGETOWN PIKE MCLEAN VA 22101
1	USDOT FEDERAL RAILRD M FATEH RDV 31 WASHINGTON DC 20590

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
3	CYTEC FIBERITE R DUNNE D KOHLI R MAYHEW 1300 REVOLUTION ST HAVRE DE GRACE MD 21078
1	MARINE CORPS INTLLGNC ACTVTY D KOSITZKE 3300 RUSSELL RD STE 250 QUANTICO VA 22134-5011
1	DIRECTOR NATIONAL GRND INTLLGNC CTR IANG TMT 220 SEVENTH ST NE CHARLOTTESVILLE VA 22902-5396
1	SIOUX MFG B KRIEL PO BOX 400 FT TOTTEN ND 58335
2	3TEX CORPORATION A BOGDANOVICH J SINGLETARY 109 MACKENAN DR CARY NC 27511
1	3M CORPORATION J SKILDUM 3M CENTER BLDG 60 IN 01 ST PAUL MN 55144-1000
1	DIRECTOR DEFENSE INTLLGNC AGENCY TA 5 K CRELLING WASHINGTON DC 20310
1	ADVANCED GLASS FIBER YARNS T COLLINS 281 SPRING RUN LANE STE A DOWNINGTON PA 19335
1	COMPOSITE MATERIALS INC D SHORTT 19105 63 AVE NE PO BOX 25 ARLINGTON WA 98223

NO. OF
COPIES ORGANIZATION

1 JPS GLASS
L CARTER
PO BOX 260
SLATER RD
SLATER SC 29683

1 COMPOSITE MATERIALS INC
R HOLLAND
11 JEWEL CT
ORINDA CA 94563

1 COMPOSITE MATERIALS INC
C RILEY
14530 S ANSON AVE
SANTA FE SPRINGS CA 90670

2 SIMULA
J COLTMAN
R HUYETT
10016 S 51ST ST
PHOENIX AZ 85044

2 PROTECTION MATERIALS INC
M MILLER
F CRILLEY
14000 NW 58 CT
MIAMI LAKES FL 33014

2 FOSTER MILLER
M ROYLANCE
W ZUKAS
195 BEAR HILL RD
WALTHAM MA 02354-1196

1 ROM DEVELOPMENT CORP
R O MEARA
136 SWINEBURNE ROW
BRICK MARKET PLACE
NEWPORT RI 02840

2 TEXTRON SYSTEMS
T FOLTZ
M TREASURE
1449 MIDDLESEX ST
LOWELL MA 01851

1 O GARA HESS & EISENHARDT
M GILLESPIE
9113 LESAINTE DR
FAIRFIELD OH 45014

NO. OF
COPIES ORGANIZATION

2 MILLIKEN RSCH CORP
H KUHN
M MACLEOD
PO BOX 1926
SPARTANBURG SC 29303

1 CONNEAUGHT INDUSTRIES INC
J SANTOS
PO BOX 1425
COVENTRY RI 02816

1 BATTELLE NATICK OPNS
B HALPIN
209 W CENTRAL ST STE 302
NATICK MA 01760

1 ARMTEC DEFENSE PRODUCTS
S DYER
85 901 AVE 53
PO BOX 848
COACHELLA CA 92236

1 NATIONAL COMPOSITE CENTER
T CORDELL
2000 COMPOSITE DR
KETTERING OH 45420

3 PACIFIC NORTHWEST LAB
M SMITH
G VAN ARSDALE
R SHIPPPELL
PO BOX 999
RICHLAND WA 99352

2 AMOCO PERFORMANCE
PRODUCTS
M MICHNO JR
J BANISAUKAS
4500 MCGINNIS FERRY RD
ALPHARETTA GA 30202-3944

8 ALLIANT TECHSYSTEMS INC
C CANDLAND MN11 2830
C AAKHUS MN11 2830
B SEE MN11 2439
N VLAHAKUS MN11 2145
R DOHRN MN11 2830
S HAGLUND MN11 2439
M HISSONG MN11 2830
D KAMDAR MN11 2830
600 SECOND ST NE
HOPKINS MN 55343-8367

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
1	SAIC M PALMER 1410 SPRING HILL RD STE 400 MS SH4 5 MCLEAN VA 22102
1	SAIC G CHRYSSOMALLIS 3800 W 80TH ST STE 1090 BLOOMINGTON MN 55431
1	AAI CORPORATION T G STASTNY PO BOX 126 HUNT VALLEY MD 21030-0126
1	APPLIED COMPOSITES W GRISCH 333 NORTH SIXTH ST ST CHARLES IL 60174
1	CUSTOM ANALYTICAL ENG SYS INC A ALEXANDER 13000 TENSOR LANE NE FLINTSTONE MD 21530
3	ALLIANT TECHSYSTEMS INC J CONDON E LYNAM J GERHARD WV01 16 STATE RT 956 PO BOX 210 ROCKET CENTER WV 26726-0210
1	OFC DEPUTY UNDER SEC DEFNS J THOMPSON 1745 JEFFERSON DAVIS HWY CRYSTAL SQ 4 STE 501 ARLINGTON VA 22202
1	PROJECTILE TECHNOLOGY INC 515 GILES ST HAVRE DE GRACE MD 21078
3	HEXCEL INC R BOE PO BOX 18748 SALT LAKE CITY UT 84118

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
5	AEROJET GEN CORP D PILLASCH T COULTER C FLYNN D RUBAREZUL M GREINER 1100 WEST HOLLYVALE ST AZUSA CA 91702-0296
1	HERCULES INC HERCULES PLAZA WILMINGTON DE 19894
1	BRIGS COMPANY J BACKOFEN 2668 PETERBOROUGH ST HERNDON VA 22071-2443
1	ZERNOW TECHNICAL SERVICES L ZERNOW 425 W BONITA AVE STE 208 SAN DIMAS CA 91773
1	GENERAL DYNAMICS OTS L WHITMORE 10101 NINTH ST NORTH ST PETERSBURG FL 33702
3	GENERAL DYNAMICS OTS FLINCHBAUGH DIV E STEINER B STEWART T LYNCH PO BOX 127 RED LION PA 17356
1	GKN AEROSPACE D OLDS 15 STERLING DR WALLINGFORD CT 06492
5	SIKORSKY AIRCRAFT G JACARUSO T CARSTENSAN B KAY S GARBO MS S330A J ADELMANN 6900 MAIN ST PO BOX 9729 STRATFORD CT 06497-9729

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
1	PRATT & WHITNEY C WATSON 400 MAIN ST MS 114 37 EAST HARTFORD CT 06108
1	AEROSPACE CORP G HAWKINS M4 945 2350 E EL SEGUNDO BLVD EL SEGUNDO CA 90245
2	CYTEC FIBERITE M LIN W WEB 1440 N KRAEMER BLVD ANAHEIM CA 92806
1	UDLP G THOMAS PO BOX 58123 SANTA CLARA CA 95052
2	UDLP R BARRETT MAIL DROP M53 V HORVATICH MAIL DROP M53 328 W BROKAW RD SANTA CLARA CA 95052-0359
3	UDLP GROUND SYSTEMS DIVISION M PEDRAZZI MAIL DROP N09 A LEE MAIL DROP N11 M MACLEAN MAIL DROP N06 1205 COLEMAN AVE SANTA CLARA CA 95052
4	UDLP R BRYNSVOLD P JANKE MS 170 4800 EAST RIVER RD MINNEAPOLIS MN 55421-1498
1	UDLP D MARTIN PO BOX 359 SANTA CLARA CA 95052
2	BOEING DFNSE & SPACE GP W HAMMOND S 4X55 J RUSSELL S 4X55 PO BOX 3707 SEATTLE WA 98124-2207

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
2	BOEING ROTORCRAFT P MINGURT P HANDEL 800 B PUTNAM BLVD WALLINGFORD PA 19086
1	BOEING DOUGLAS PRODUCTS DIV L J HART SMITH 3855 LAKEWOOD BLVD D800 0019 LONG BEACH CA 90846-0001
1	LOCKHEED MARTIN SKUNK WORKS D FORTNEY 1011 LOCKHEED WAY PALMDALE CA 93599-2502
1	LOCKHEED MARTIN R FIELDS 1195 IRWIN CT WINTER SPRINGS FL 32708
1	MATERIALS SCIENCES CORP G FLANAGAN 500 OFC CENTER DR STE 250 FT WASHINGTON PA 19034
1	NORTHROP GRUMMAN CORP ELECTRONIC SENSORS & SYSTEMS DIV E SCHOCH MS V 16 1745A W NURSERY RD LINTHICUM MD 21090
1	GDLS DIVISION D BARTLE PO BOX 1901 WARREN MI 48090
2	GDLS D REES M PASIK PO BOX 2074 WARREN MI 48090-2074
1	GDLS MUSKEGON OPERATIONS W SOMMERS JR 76 GETTY ST MUSKEGON MI 49442

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>	<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
1	GENERAL DYNAMICS AMPHIBIOUS SYS SURVIVABILITY LEAD G WALKER 991 ANNAPOLIS WAY WOODBIDGE VA 22191	1	IIT RESEARCH CENTER D ROSE 201 MILL ST ROME NY 13440-6916
6	INST FOR ADVANCED TECH H FAIR I MCNAB P SULLIVAN S BLESS W REINECKE C PERSAD 3925 W BRAKER LN STE 400 AUSTIN TX 78759-5316	1	GA TECH RSCH INST GA INST OF TCHNLGY P FRIEDERICH ATLANTA GA 30392
2	CIVIL ENGR RSCH FOUNDATION PRESIDENT H BERNSTEIN R BELLE 1015 15TH ST NW STE 600 WASHINGTON DC 20005	1	MICHIGAN ST UNIV MSM DEPT R AVERILL 3515 EB EAST LANSING MI 48824-1226
1	ARROW TECH ASSO 1233 SHELBURNE RD STE D8 SOUTH BURLINGTON VT 05403-7700	1	UNIV OF WYOMING D ADAMS PO BOX 3295 LARAMIE WY 82071
1	R EICHELBERGER CONSULTANT 409 W CATHERINE ST BEL AIR MD 21014-3613	2	PENN STATE UNIV R MCNITT C BAKIS 212 EARTH ENGR SCIENCES BLDG UNIVERSITY PARK PA 16802
1	UCLA MANE DEPT ENGR IV H T HAHN LOS ANGELES CA 90024-1597	1	PENN STATE UNIV R S ENGEL 245 HAMMOND BLDG UNIVERSITY PARK PA 16801
2	UNIV OF DAYTON RESEARCH INST R Y KIM A K ROY 300 COLLEGE PARK AVE DAYTON OH 45469-0168	1	PURDUE UNIV SCHOOL OF AERO & ASTRO C T SUN W LAFAYETTE IN 47907-1282
1	UMASS LOWELL PLASTICS DEPT N SCHOTT 1 UNIVERSITY AVE LOWELL MA 01854	1	STANFORD UNIV DEPT OF AERONAUTICS & AEROBALLISTICS S TSAI DURANT BLDG STANFORD CA 94305
		1	UNIV OF MAIN ADV STR & COMP LAB R LOPEZ ANIDO 5793 AEWC BLDG ORONO ME 04469-5793

NO. OF COPIES	ORGANIZATION
1	JOHNS HOPKINS UNIV APPLIED PHYSICS LAB P WIENHOLD 11100 JOHNS HOPKINS RD LAUREL MD 20723-6099
1	UNIV OF DAYTON J M WHITNEY COLLEGE PARK AVE DAYTON OH 45469-0240
5	UNIV OF DELAWARE CTR FOR COMPOSITE MTRLs J GILLESPIE M SANTARE S YARLAGADDA S ADVANI D HEIDER 201 SPENCER LABORATORY NEWARK DE 19716
1	DEPT OF MATERIALS SCIENCE & ENGINEERING UNIVERSITY OF ILLINOIS AT URBANA CHAMPAIGN J ECONOMY 1304 WEST GREEN ST 115B URBANA IL 61801
1	NORTH CAROLINA STATE UNIV CIVIL ENGINEERING DEPT W RASDORF PO BOX 7908 RALEIGH NC 27696-7908
1	UNIV OF MARYLAND DEPT OF AEROSPACE ENGNRNG A J VIZZINI COLLEGE PARK MD 20742
3	UNIV OF TEXAS AT AUSTIN CTR FOR ELECTROMECHANICS J PRICE A WALLS J KITZMILLER 10100 BURNET RD AUSTIN TX 78758-4497
1	DREXEL UNIV A S D WANG 32ND & CHESTNUT ST PHILADELPHIA PA 19104

NO. OF COPIES	ORGANIZATION
3	VA POLYTECHNICAL INST & STATE UNIV DEPT OF ESM M W HYER K REIFSNIDER R JONES BLACKSBURG VA 24061-0219
1	SOUTHWEST RSCH INST ENGR & MATL SCIENCES DIV J RIEGEL 6220 CULEBRA RD PO DRAWER 28510 SAN ANTONIO TX 78228-0510

ABERDEEN PROVING GROUND

1	US ARMY MATERIEL SYSTEMS ANALYSIS ACTIVITY P DIETZ 392 HOPKINS RD AMXS TD APG MD 21005-5071
1	DIRECTOR US ARMY RESEARCH LAB AMSRL OP AP L APG MD 21005-5066
90	DIR USARL AMSRL CI AMSRL CI S A MARK AMSRL CS IO FI M ADAMSON AMSRL SL BA AMSRL SL BL D BELY R HENRY AMSRL SL BG AMSRL SL I AMSRL WM J SMITH AMSRL WM B A HORST AMSRL WM BA D LYON

NO. OF
COPIES ORGANIZATION

ABERDEEN PROVING GROUND (CONT)

AMSRL WM BC
P PLOSTINS
J NEWILL
S WILKERSON
A ZIELINSKI
AMSRL WM BD
B FORCH
R FIFER
R PESCE RODRIGUEZ
B RICE
AMSRL WM BE
C LEVERITT
AMSRL WM BF
J LACETERA
AMSRL WM BR
C SHOEMAKER
J BORNSTEIN
AMSRL WM M
D VIECHNICKI
G HAGNAUER
J MCCAULEY
AMSRL WM MA
L GHIORSE
S MCKNIGHT
AMSRL WM MB
B FINK
J BENDER
T BOGETTI
R BOSSOLI
L BURTON
K BOYD
S CORNELISON
P DEHMER
R DOOLEY
W DRYSDALE
G GAZONAS
S GHIORSE
D GRANVILLE
D HOPKINS
C HOPPEL
D HENRY
R KASTE
M KLUSEWITZ
M LEADORE
R LIEB
E RIGAS
J SANDS
D SPAGNUOLO
W SPURGEON
J TZENG

NO. OF
COPIES ORGANIZATION

ABERDEEN PROVING GROUND (CONT)

E WETZEL
A FRYDMAN
AMRSL WM MC
J BEATTY
E CHIN
J MONTGOMERY
A WERECZCAK
J LASALVIA
J WELLS
AMSRL WM MD
W ROY
S WALSH
AMSRL WM T
B BURNS
M ZOLTOSKI
AMSRL WM TA
W GILLICH
T HAVEL
J RUNYEON
M BURKINS
E HORWATH
B GOOCH
W BRUCHEY
M NORMANDIA
AMRSL WM TB
D KOOKER
P BAKER
AMSRL WM TC
R COATES
AMSRL WM TD
A DAS GUPTA
T HADUCH
T MOYNIHAN
F GREGORY
M RAFTENBERG
M BOTELER
T WEERASOORIYA
D DANDEKAR
A DIETRICH
AMSRL WM TE
A NIILER
J POWELL
AMSRL SS SD
H WALLACE
AMSRL SS SE DS
R REYZER
R ATKINSON

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
1	LTD R MARTIN MERL TAMWORTH RD HERTFORD SG13 7DG UK
1	SMC SCOTLAND P W LAY DERA ROSYTH ROSYTH ROYAL DOCKYARD DUNFERMLINE FIFE KY 11 2XR UK
1	CIVIL AVIATION ADMINISTRATION T GOTTESMAN PO BOX 8 BEN GURION INTERNL AIRPORT LOD 70150 ISRAEL
1	AEROSPATIALE S ANDRE A BTE CC RTE MD132 316 ROUTE DE BAYONNE TOULOUSE 31060 FRANCE
1	DRA FORT HALSTEAD P N JONES SEVEN OAKS KENT TN 147BP UK
1	DEFENSE RESEARCH ESTAB VALCARTIER F LESAGE COURCELETTE QUEBEC COA IRO CANADA
1	SWISS FEDERAL ARMAMENTS WKS W LANZ ALLMENDSTRASSE 86 3602 THUN SWITZERLAND
1	DYNAMEC RESEARCH AB AKE PERSSON BOX 201 SE 151 23 SODERTALJE SWEDEN

<u>NO. OF COPIES</u>	<u>ORGANIZATION</u>
1	ISRAEL INST OF TECHNOLOGY S BODNER FACULTY OF MECHANICAL ENGR HAIFA 3200 ISRAEL
1	DSTO AMRL WEAPONS SYSTEMS DIVISION N BURMAN RLLWS SALISBURY SOUTH AUSTRALIA 5108 AUSTRALIA
1	ECOLE ROYAL MILITAIRE E CELENS AVE DE LA RENAISSANCE 30 1040 BRUXELLE BELGIQUE
1	DEF RES ESTABLISHMENT VALCARTIER A DUPUIS 2459 BOULEVARD PIE XI NORTH VALCARTIER QUEBEC CANADA PO BOX 8800 COURCELETTE GOA IRO QUEBEC CANADA
1	INSTITUT FRANCO ALLEMAND DE RECHERCHES DE SAINT LOUIS DE M GIRAUD 5 RUE DU GENERAL CASSAGNOU BOITE POSTALE 34 F 68301 SAINT LOUIS CEDEX FRANCE
1	ECOLE POLYTECH J MANSON DMX LTC CH 1015 LAUSANNE SWITZERLAND

NO. OF COPIES	ORGANIZATION
1	TNO PRINS MAURITS LABORATORY R IJSSELSTEIN LANGE KLEIWEG 137 PO BOX 45 2280 AA RIJSWIJK THE NETHERLANDS
2	FOA NATL DEFENSE RESEARCH ESTAB DIR DEPT OF WEAPONS & PROTECTION B JANZON R HOLMLIN S 172 90 STOCKHOLM SWEDEN
2	DEFENSE TECH & PROC AGENCY GROUND I CREWTHERR GENERAL HERZOG HAUS 3602 THUN SWITZERLAND
1	MINISTRY OF DEFENCE RAFAEL ARMAMENT DEVELOPMENT AUTH M MAYSELESS PO BOX 2250 HAIFA 31021 ISRAEL
1	TNO DEFENSE RESEARCH I H PASMAN POSTBUS 6006 2600 JA DELFT THE NETHERLANDS
1	B HIRSCH TACHKEMONY ST 6 NETAMUA 42611 ISRAEL
1	DEUTSCHE AEROSPACE AG DYNAMICS SYSTEMS M HELD PO BOX 1340 D 86523 SCHROBENHAUSEN GERMANY

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project(0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE September 2001		3. REPORT TYPE AND DATES COVERED Final, May-July 2001
4. TITLE AND SUBTITLE High-Strain Rate Uniaxial Compression of Future Combat Systems (FCS) Generation One High-Energy Gun Propellants			5. FUNDING NUMBERS 1L161102AH43	
6. AUTHOR(S) Michael G. Leadore				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Research Laboratory ATTN: AMSRL-WM-MB Aberdeen Proving Ground, MD 21005-5069			8. PERFORMING ORGANIZATION REPORT NUMBER ARL-TR-2571	
9. SPONSORING/MONITORING AGENCY NAMES(S) AND ADDRESS(ES)			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) Six lots of Thiokol-manufactured Future Combat Systems (FCS) Generation One experimental high-energy gun propellants were tested in uniaxial compression. The materials were taken to ~60% strain at a strain rate of 100 per second, while conditioned at 21 °C, 63 °C, and -32 °C. The stress at yield, strain at yield, Young's modulus, failure modulus, incremental energy density, and fracture assessment values were recorded for each test. The average values achieved are reported.				
14. SUBJECT TERMS Thiokol, future combat systems, high-energy, gun propellants, fracture, modulus, failure modulus, high-strain rate			15. NUMBER OF PAGES 31	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

INTENTIONALLY LEFT BLANK.